(Bulletins 316 to 321 constitute the Report for 1924. In binding, pages i-xii at the end of this bulletin should be detached and placed before Bulletin 316 which begins with page 1.)

Maine Agricultural Experiment Station

ORONO

BULLETIN 321 **DECEMBER, 1924**

ABSTRACTS OF PAPERS NOT INCLUDED IN BULLETINS, FINANCES, METEOROLOGY, INDEX.

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AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

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AND THE HEADS AND ASSOCIATES OF STATION DEPARTMENTS, AND THE DEAN OF THE COLLEGE OF AGRICULTURE

THE STATION STAFF

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BULLETIN 321

ABSTRACTS OF PAPERS PUBLISHED BY THE STATION IN 1924 BUT NOT INCLUDED IN THE BULLETINS.

A complete list of all the publications issued by and from the Station in 1924 is given on pages x-xi of the introduction to this Report. The following pages contain abstracts of the papers issued during the year that are not included in the Bulletins or Official Inspections for the year.

THE NATURE OF SIZE INHERITANCE*

The study of the inheritance of size differences has been difficult because a large number of size factors are usually present which cannot be distinguished in their effect and the effects of any single factor for size differences cannot be studied. It has been possible, however, by a study of a number of simple qualitative factors such as color and pattern in beans to find size differences associated with the simple qualitative differences. The association of these characters would indicate that size factors must be linked in the same chromosome with factors for color or pattern of the seed coat and accordingly the size factor or factors in any given chromosome can be studied.

Experiments conducted in 1922 indicated that there was linkage between size of seed and color, pattern and extent of pigmentation in certain bean hybrids. In a cross of Improved Yellow Eye X White 1228 it was possible to study the effect of the size factor or factors in a single chromosome when present in the 1n condition by taking advantage of the knowledge obtained from an analysis of the inheritance of the mottling pattern. Segregates which were heterozygous for the mottling factor and were accordingly heterozygous for size factors in this particular chromosome were intermediate in regard to seed weight between the self-colored segregates and the homozygous mottled segre-

*This is an abstract of a paper by Karl Sax, having the same title and published in The Proceedings of the National Academy of Science, Vol. 10, pp. 224-227. 1924.

gates. This behavior would indicate that the size factor or factors in this particular chromosome in the heterozygous condition are only half as effective as they are in the homozygous condition, indicating the lack of dominance of the size factors in this particular case.

Experiments conducted in 1923 showed that size differences in total yield were also linked with pattern. In the cross referred to above the mottled segregates in F_3 were significantly more productive than the self-colored segregates. The White segregates in F_3, of which three-eighths are homozygous for mottling and two-eighths heterozygous for mottling, were approximately intermediate in yield between the self-colored and the mottled. The segregation of the mottling factor among the whites cannot, of course, be studied, due to the absence of the pigmentation factor. These results show clearly that differences in size and total yield are to some extent at least, dependent on genetic factors which are linked with factors for simple qualitative differences and are therefore inherited in the usual Mendelian manner.

A GENETIC AND CYTOLOGICAL STUDY OF CERTAIN HYBRIDS OF WHEAT SPECIES.*

Crosses between wheat species of the emmer group with 14 chromosomes, with members of the vulgare group with 21 chromosomes, result in partially sterile F_1 hybrids, and all degrees of sterility in F_2. Previous cytological studies of chromosome number and behavior in F_1 and F_2 indicate that gametes and segregates with an intermediate chromosome number tend to be eliminated through sterility and that the ultimate homozygous fertile segregates will have either 14 or 21 chromosomes. Segregates with 14 chromosomes resemble the emmer parent in most respects while segregates with 21 chromosomes possess most of the vulgare characters, indicating that the 7 additional chromosomes determine the differentiating characters of the vulgare wheats.

The elimination of gametes and segregates with an intermediate chromosome number would disturb genetic segregation

*This is an abstract of a paper by Karl Sax and E. F. Gaines, having the same title and published in the Journal of Agricultural Research, Vol. XXVIII, No. 10, pp. 1017-1032. 2 plates.

in case of factors located in the 7 chromosomes contributed by the vulgare parent which do not pair in the reduction division of F_1 crosses between emmer and vulgare wheats. Normal Mendelian segregation should usually occur with those factors located in the 14 emmer and vulgare chromosomes which pair in F_1 hybrids. Thus one might expect normal Mendelian segregation of characters common to the two groups of wheat species and aberrant segregation of characters which distinguish the two groups. Of the characters analyzed in both F_2 and F_3 of such species crosses, the presence or absence of awns, yellow or black awns, and red and white grain are all characters found in either the emmer group or the vulgare group although black awns are rare in vulgare wheats. The segregation of awn length into so-called awnless (tip-awned) and awned is clearly dependent on a single factor difference and a normal Mendelian segregation is obtained. The segregation of awn color is complicated by the effect of environmental factors, but F_3 classification indicates a simple Mendelian ratio. The number of segregates with white grain in the cross of Marquis X Alaska would indicate the presence of two factors for red color although the number of segregating individuals is greater than expected.

On the other hand, the characters which distinguish the emmer and vulgare groups apparently do not segregate in a Mendelian fashion. Most varieties of the emmer group have very hard flinty kernels, a large sharp keel on the outer glume and some varieties have branched spikes. These characters are found in no vulgare variety. Since these characters are common to all of the varieties in the emmer group it is impossible to determine how they are inherited in fertile varietal crosses. There is, however, one exception in the case of Alaska. Alaska has the branched spike while the durums and emmer wheats have a normal spike. The cross of Alaska X Emmer resulted in an apparently simple ratio of normal and branched, or at least the genetic behavior is entirely different than in the species hybrids. The non-Mendelian segregation of these typical emmer characters in the species hybrids suggests that they may be dependent on the presence or absence of factors located in the extra seven vulgare chromosomes which do not pair in crosses with emmer wheat. Since these seven chromosomes are irregularly distributed and

certain classes are apparently eliminated due to sterility, a normal Mendelian segregation would not be expected.

Certain crosses between members of the vulgare group and members of the emmer group are more fertile than others. In the more fertile crosses segregates may possess certain combinations of parental characters and intermediate chromosome numbers while in the more sterile crosses the intermediate types would be rapidly eliminated and the surviving segregates would have either 14 or 21 chromosomes and would resemble the parental species. Thus there should be considerable correlation or association of the characters contributed by each parent in the more sterile hybrids while in the more fertile crosses there would be less tendency for the characters of each parent to be associated. This is actually the case. These results would indicate that combinations of the characters of the emmer and vulgare wheats can be obtained more frequently in the more fertile combinations. However, many plant breeders have attempted to combine the drought and disease resistance of the emmer species with the high quality of the vulgare wheats without successful results.

In general, the intermediate types of segregates are more sterile than segregates resembling one parent or the other. Individuals resembling the economic species of wheat are more fertile than those which can not be so classed.

There is a greater proportion of intermediate types in the more fertile species hybrids, which may indicate that more of the segregates can function with an intermediate chromosome number in such crosses. A cytological examination of F_4 segregates shows that the intermediate types usually have an intermediate chromosome number, but some of the segregates with 14 and 21 chromosomes also possess characteristics of both parents. The presence of some of the typical vulgare characters in 14 chromosome segregates and the occasional recovery of emmer characters in 21 chromosome segregates suggest that the chromosomes which carry factors for the distinguishing vulgare characters may in some cases at least pair with certain of the emmer chromosomes in crosses between members of the two groups. The combinations of typical emmer and vulgare characters in certain segregates indicates that the differentiating vulgare characters are determined by factors in individual chromosomes and not by the combined effect of the additional seven chromosomes.

Although in the more fertile crosses there are many segregates with intermediate chromosome numbers, it is questionable if such segregates can persist in a homozygous fertile condition. Certain combinations of emmer and vulgare characters do occur in segregates with 14 or 21 chromosomes and it is probable that a small proportion of segregates can be obtained which will combine certain characters of the two groups of species, especially in the more fertile combinations. From a practical standpoint, however, it would probably be more feasible to combine disease resistance and yield and quality of grain by selecting the parents within the vulgare group. It is perhaps significant that crosses of vulgare varieties are apparently the only ones which have resulted in new varieties of economic importance.

CHROMOSOME BEHAVIOR IN A GENUS CROSS*

A cross of *Aegilops cylindrica*, a wild grass found in the Mediterranean region, with Marquis wheat, one of the leading varieties of *Triticum vulgare*, resulted in vigorous, but completely sterile, F_1 plants.

Aegilops cylindrica has 14 haploid chromosomes while the wheat variety used has 21 gametic chromosomes. Thus the F_1 plant has 35 chromosomes in the somatic cells. In the first reduction division of the pollen mother cells of the F_1 plant there are about 7 bivalent and 21 univalent chromosomes, due presumably to the pairing of 7 *Aegilops* chromosomes with 7 wheat chromosomes. If the single chromosomes are distributed at random in the reduction divisions, as appears probable, then the chromosome number of the gametes will vary from 7 to 28.

Sterility in this genus cross is due to the incompatibility of certain chromosomes and to chromosome differences in the parents, both of which factors result in univalent chromosomes in the reduction divisions of the F_1 hybrid. With random distribution of the 21 single chromosomes there is little chance of obtaining gametes in multiples of 7. If only gametes with a chromosome number in multiples of 7 survive, as is the case in

*This is an abstract of a paper by Karl Sax and Hally Jolivette Sax, having the same title and published in Genetics 9: pp. 454-464, September, 1924.

crosses of wheat species, then most of the sterility can be accounted for. If each set of 7 chromosomes must consist of specific individuals then the chances of recovering fertile gametes are extremely small.

Theoretically, it is possible for a new species with 28 chromosomes to be derived from this genus cross, but the chances for such an occurence are extremely small.

The behavior of the chromosomes in this cross suggests the possible origin of the vulgare wheats from a cross of *Aegilops* with a wheat species of the Emmer series.

The chromosomes of the two genera, *Aegilops* and *Triticum*, are more compatible with each other, as indicated by the number which pair, than the chromosomes of certain species within a given genus.

NURSERY STOCK INVESTIGATIONS*

This is a further report of the work described in Bulletin 315 of this Station. Bud selection was found to be ineffective in most cases in increasing the size of the nursery trees. In a few cases differences were found in favor of the buds from the large productive parent, but further work is necessary to determine the consistency and value of such selections.

The rate of the growth of the grafted bud in the spring caused some differences in the size of the one-year whip but had little effect on the size of the two-year old tree. Differences in the size of the seedling root stocks were even more effective in controlling the size of the two-year whips than in controlling the size of the one-year old trees.

In one experiment buds were placed upside down where permanent branches were desired on the one-year old whip. The branches developed from these buds tend to grow towards the ground but soon turn up and form a well spread frame work. This method also avoids undesirable crotches and may be of practical value with certain varieties.

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*This is an abstract of a paper by Karl Sax having the same title and published in the Proceedings of the American Society for Horticultural Science, 1924.

THE PROBABLE ERROR IN HORTICULTURAL EXPERIMENTS.*

The usual method of obtaining probable errors of differences are subject to two sources of errors, due to the comparatively small number of trees usually involved and in making the assumption that there is no correlation between the trees or plots which are being compared.

If the number of individuals is comparatively small, say less than 20, the value of the standard deviation will usually be less than the standard deviation of the true population and the probable error will be correspondingly decreased. The actual application of this principle was tested by selecting 4, 8, and 16 trees at a time from a population of 59 trees. Each class was selected at random 60 times, returning the cards after each selection. It was found that the average standard deviations were 181 for 4 trees, 213 for 8 trees, 226 for 16 trees and 231 for 59 trees. Pearson has calculated tables to correct the standard deviation for small values of n. The standard deviations of these various classes were corrected with the constants represented by Pearson, and they were then found to be very near the standard deviations for the total population.

The second source of error in calculating the probable error of a difference is in assuming that there is no correlation between the two frequency distributions under comparison. The probable error of a difference is equal to:

$$.6745 \sqrt{\frac{\sigma_1^2 + \sigma_2^2 - 2r_{1\,2}\,\sigma_1\,\sigma_2}{n}}$$

The last term of this formula has commonly been neglected, because it has been assumed that there is no correlation in the two distributions under comparison. In most horticultural experiments, however, there will be considerable correlation between the trees or plots, due to soil or climatic conditions and if yields are taken over a series of years there will be a high correlation between contrasted plots, due to seasonal variations. It is shown

*This is an abstract of a paper by Karl Sax having the same title and published in the Proceedings of the American Society for Horticultural Science, 1924.

that in one comparison of two fertilizer plots that the odds are only about 5:1 that the differences are significant when the usual method for obtaining the probable error of a difference is used. When the complete formula is used it was found that the odds are more than half a million to one that one plot is more productive than the other. The use of the complete formula is complicated by the fact that the value of the correlation coefficients cannot be accurately determined with small values of n, and the labor of making this calculation takes considerable time. An investigator who has signed himself "Student" has developed a method for determining the significance of the difference between two means which is in accord with the results obtained using a complete formula but which is very much simpler in its application. The use of this method is compared with the usual method and with the complete formula for obtaining the probable error of a difference. This method also facilitates the calculation of a probable number of plots or trees which should be used to obtain significant results. "Student's" method is accordingly recommended for most types of horticultural experiments where varieties or differential treatments are under comparison.

INHERITANCE OF MILK PRODUCTION*

This paper presents a brief summary of the inheritance work on milk production and butter-fat percentage in cattle, considered from the point of view of the breeder desiring to purchase stock. The guide which the breeder uses in the purchase of this stock is the pedigree. The study of the pedigree shows; first, there appears to be little or no influence of inbreeding, of relationship, or of famous ancestors on the production of the progeny of dairy sires. It will be noted that the evidence shows that the inbreeding and relationship which occurs in the ordinary pedigrees as found in our purebred breeds is relatively small in amount. The evidence from extensive experiments (on small animals particularly) shows that very intensive inbreeding such as mating brother and sister for a number of generations will generally result in the concentration of the prepotency of this animal but also in

*This is an abstract of a paper by John W. Gowen, having the same title and published in Scientific Agriculture, Vol. IV, No. 12, pp. 365-380. 1924.

a decline in vigor in such inbred animals and a probable reduction in fertility. These last results may, however, be avoided by very careful selections.

It is indicated further that it is desirable to have animals which are registered because these registration papers show that a definite effort has been made to breed these animals to certain types of production and because this definite effort tends to make these animals pure for these types of production and consequently transmit them as increased milk yields and butter-fat percentages to their offspring more frequently than animals of unknown breeding with probable mixed ancestry.

It is further shown that the parents and grandparents, sisters and half sisters, and to some extent cousins are the important relatives on which to base an estimate of the productive worth of an animal. As a pedigree goes beyond three or four generations the ancestors in it get so far removed from the animal pedigreed that the effect of any worthy ancestor even though pure for high production is diluted so much by the other ancestors in coming down through the generations that its effect on the animal pedigree is so slight as to be of little or no value as a prediction of the progeny's probable production.

It is further shown that the animals on which greatest dependence may be placed in reading a pedigree are the recorded performances of the dam, full sisters, and half sisters. Next to these come the recorded performances of the grandparents.

THE APPLICATION OF THE SCIENCE OF GENETICS TO THE FARMERS' PROBLEMS*

This paper presents a review of the methods and accomplishments as developed in the study of breeding problems as related to the progress of practical agriculture. It is shown that in contrast to the lack of improvement of animals and plants resulting from the use of mass selection method that when progeny performance selection was discovered and practiced there resulted a steady increase in the yield of all forms of crops and of breeding stock. Oats, barley, beans, cow peas, wheat, have all shared in this increase in yield due to the breeding of improved

*This is an abstract of a paper by John W. Gowen having the same title and published in Scientific Agriculture, Vol. V, No. 1, pp. 1-12.

strains of seed by the use of these methods. One of the striking examples of such increase is shown by Maine 340 oats. This oat under actual tests by Maine farmers produced 22 bushels per acre more than the other commercial varieties with which it was compared. Poultry has similarly shared in such increases especially after the work of the Maine Station, indicated this as the proper method of selection.

Some varieties of crops and farm animals need an occasional wide outcross to stimulate increased production. This is shown particularly in corn and to some extent in such crosses as those of Aberdeen Angus and Shorthorn or Galloway and Shorthorn made for the production of fancy beef animals. Some indication of the need of this method of crossing is also found in poultry.

A favorite method of breeding has consisted of crossing two varieties each of which have a desirable characteristic which it is hoped to combine in a single individual, thus creating a new strain carrying both desirable qualities. The citation of a list of economically valuable crops to agriculture formed by this means would be very large indeed. Marquis wheat is one of the striking examples. Round Tip tobacco such as is used in the Connecticut industry is another such made to order plant.

This method is not always applicable. It must be accompanied by careful study of the behavior of the crossed plant's chromosomes, especially when sterility is present.

The importance of good root stocks as a means of propagation of grafted varieties is shown in the orange, lemon, grapefruit and the apple. If these root stocks are vigorous the tree resulting from the graft of the scion into such stock tends to be more vigorous than when the root stock is of poor quality.

The breeder has contributed a good deal of information with regard to the causes of low productivity found in large blocks of trees when planted together. The cause of this sterility appears to be in the improper functioning of the pollen on flowers of its own variety. The remedy consists of bringing in other pollen varieties into the orchard.

A summary is given of the progress in the study of breeding problems in dairy cattle showing the importance of the performance of the progeny of dairy sires and the method by which the breeder may obtain this information. A table is presented for

the first forty-three Guernsey sires' performance in milk production together with a discussion of the information which may be obtained therefrom.

THE INHERITANCE OF MILK PRODUCTION AND BUTTER-FAT PERCENTAGE.*

This paper presents a summary of the information on the choice of cattle by means of type, of pedigree and of performance. Type is shown to have some relation to the milk production of dairy cattle but little or no relation to their butter-fat percentage. The pedigree is of but doubtful value save when accompanied by records on a large number of animals found within the pedigree. The choice of dairy cattle by their performance is shown to be by far the most important means of selecting cattle and guiding breeding operations desired to increase the productivity of the dairy herd.

INTRA-UTERINE DEVELOPMENT OF THE BOVINE FOETUS IN RELATION TO MILK YIELD IN GUERNSEY CATTLE.†

The data presented show that the carrying of the calf is a slight but significant drain on the mother's milk producing capacity, amounting to from 400 to 600 pounds of milk with an energy value of about 125 to 200 therms. The carrying of the foetus has no influence on the butter-fat percentage of the milk produced by the cow.

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*This is an abstract of a paper by John W. Gowen having the same title and published in the Proceedings of the World's Dairy Congress, Vol. II, pp. 1389-1396.

†This is an abstract of a paper by John W. Gowen having the same title and published in the Journal of Dairy Science, Vol. VII, No. 4, pp. 311-317.

METEOROLOGICAL OBSERVATIONS.

For many years the meteorological apparatus was located in the Experiment Station building and the observations were made by members of the Station Staff. June 1, 1911, the meteorological apparatus was removed to Wingate Hall and the observations are in charge of Dr. James S. Stevens, professor of physics in the University of Maine.

In September, 1914, the meteorological apparatus was moved to Aubert Hall, the present headquarters of the physics department.

The instruments used are at Lat. 44° 54′ 2″ N., Lon. 64° 40′ 5″ W. Elevation 135 feet.

The instruments used are the same as those used in preceding years, and include: Maximum and minimum thermometers; rain guage; self-recording anemometer; vane; and barometers. The observations at Orono now form an almost unbroken record of fifty-six years.

1924	January	February	March	April	May	June	July	August	September	October	November	December	Average	Total
Highest temperature	46	43	54	66	69	85	88	86	81	72	59	40	-------	-------
Lowest temperature	–19	–15	3	19	29	39	48	42	28	19	7	–13	-------	-------
Mean temperature	16.76	13.7	31.66	38.38	48.11	58.48	67.01	64.4	55.2	47.01	35.1	15.97	40.981	-------
Mean temperature in 56 years	15.94	14.77	30.12	39.35	51.22	61.14	65.99	65.75	59.36	49.5	37.53	23.22	42.823	-------
Total precipitation in inches	4.46	3.03	1.44	3.98	3.03	2.47	1.91	3.69	3.32	1.39	3.59	4.74	-------	37.05
Mean total precipitation in 56 years	2.62	1.65	3.83	6.92	3.37	3.41	3.31	2.36	3.34	3.68	3.34	3.37	-------	41.19
Number of days with .01 precipitation or more	10	3	6	5	10	8	5	10	6	4	4	7	-------	78
Snowfall in inches	14	17.5	3.5	12	-------	-------	-------	-------	-------	-------	12	20.5	-------	79.5
Mean snowfall in 56 years	21.54	21.93	14.54	5.80	-------	-------	-------	-------	-------	.012	6.60	16.04	-------	86.46
Number of clear days	12	10	10	7	7	7	13	12	10	15	9	5	-------	117
Number of fair days	9	5	8	8	10	14	13	9	7	4	4	13	-------	104
Number of cloudy days	10	14	13	15	14	9	5	10	13	12	17	13	-------	145
Average velocity of wind per hour in miles	6.071	4.872	6.402	7.398	7.223	5.065	5.014	3.60	4.443	5.80	5.73	4.99	5.30	-------

REPORT OF THE TREASURER.

The Station is a department of the University and its accounts are kept in the office of the Treasurer of the University. The books, voucher files, etc., are, however, all distinct from those of the other departments of the University. The classification of accounts is that prescribed by the auditors on the part of the Federal Government, and approved by the State Auditor. All of the accounts are audited by the State Auditor, and the Hatch Fund and Adams Fund accounts are also audited by the Office of Experiment Stations acting for the United States Secretary of Agriculture in accordance with Federal Law.

The income of the Station from public sources for the year that ended June 30, 1924, was:

U. S. Government, Hatch Fund appropriation	$15,000.00
U. S. Government, Adams Fund appropriation	15,000.00
State of Maine, Animal Husbandry investigation appropriation	5,000.00
State of Maine, Aroostook Farm investigation	5,000.00
State of Maine, Highmoor Farm investigations	5,000.00
State of Maine, General Maintenance	10,000.00

The cost of maintaining the laboratories for the inspection analyses is borne by analysis fees and by the State Department of Agriculture. The income from sales at the experiment farms and poultry plant is used for the expense of investigations. The printing is paid for by an appropriation to the University.

At Aroostook Farm there are in connection with the cooperative work with the Federal Department of Agriculture expenditures mostly under "labor" for the Department and for which the Station is reimbursed. There are also certain expenditures for the Department made from sales of crops from Department investigations that do not appear in the tabular statements. They are carried as distinct and separate accounts, always with credit balances, on the Station ledger.

REPORT OF THE TREASURER FOR YEAR ENDING JUNE 30, 1924.

DISBURSEMENTS.

	Hatch Fund	Adams Fund	State Maintenance
Salaries	$7,516.07	$15,000.00	$3,340.02
Labor	3,649.48	--------	1,217.42
Stationery and Office Supplies	166.19	--------	270.84
Scientific Supplies	95.28	--------	227.34
Feeding Stuffs	1,316.62	--------	619.00
Sundry Supplies	142.98	--------	513.41
Fertilizers	--------	--------	435.18
Communication Service	191.15	--------	37.69
Travel	280.88	--------	473.15
Transportation of things	143.93	--------	177.30
Publications	271.00	--------	75.93
Heat, Light and Water	765.55	--------	84.97
Furniture, Furnishings and Fixtures	17.42	--------	381.47
Library	319.41	--------	309.23
Scientific Equipment	75.00	--------	41.19
Live Stock	--------	--------	68.00
Tools, Machinery and Appliances	41.86	--------	720.97
Buildings and land	7.18	--------	984.27
Contingent Expenses	--------	--------	22.62
Total	$15,000.00	$15 000.00	$10,000.00

REPORT OF THE TREASURER FOR YEAR ENDING JUNE 30, 1924.

DISBURSEMENTS.

	Aroostook Farm	Highmoor Farm	Animal Husbandry	General Account	Inspection Analysis
Salaries	$1,300.00	$1,700.00	--------	--------	$10,944.96
Labor	4,996.89	2,487.35	3,613.09	47.08	42.44
Stationery and Office Supplies	15.40	--------	105.00	17.51	48.15
Scientific Supplies	--------	335.95	--------	50.70	203.22
Feeding Stuffs	108.95	1,278.09	2,928.48	144.85	13.80
Sundry Supplies	851.02	--------	577.60	43.27	7.60
Fertilizers	974.40	--------	--------	--------	--------
Communication Service	21.55	52.85	4.60	13.25	48.32
Travel	124.18	34.40	43.35	296.19	50.17
Transportation of things	70.46	226.13	380.93	42.83	98.06
Publications	--------	--------	--------	--------	--------
Heat, Light and Water	338.46	290.14	632.10	10.97	386.05
Furniture, Furnishings and Fixtures	264.98	10.50	56.16	866.15	--------
Library	--------	--------	--------	69.17	8.00
Scientific Equipment	--------	--------	--------	315.25	25.30
Live Stock	--------	--------	--------	--------	--------
Tools, Machinery and Appliances	922.60	666.08	513.47	7.35	--------
Buildings and land	208.86	62.63	68.96	41.70	--------
Contingent Expenses	121.04	114.14	247.00	117.44	10.00
Total	$10,618.79*	$7,258.26†	$9,170.74‡	$2,083.71	$11,886.07

*$5,618.79 from sales funds.
†$2,258.26 from sales funds.
‡$4,170.74 from sales funds.

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FORTIETH ANNUAL REPORT

OF THE

Maine Agricultural Experiment Station

ORONO, MAINE

1924

UNIVERSITY OF MAINE

1924

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

ORGANIZATION JANUARY TO JUNE, 1924

THE STATION COUNCIL

PRESIDENT CLARENCE C. LITTLE,	*President*
DIRECTOR WARNER J. MORSE,	*Secretary*
ORA GILPATRICK, Houlton,	*Committee of Board of Trustees*
THOMAS E. HOUGHTON, Fort Fairfield,	*Committee of Board of Trustees*
FRANK E. GUERNSEY, Dover,*	*Committee of Board of Trustees*
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JOHN W. LELAND, Dover-Foxcroft,	*State Dairymen's Association*
LEONARD C. HOLSTON, Cornish,†	*Maine Livestock Breeders' Ass'n.*
WILLIAM G. HUNTON, Portland,	*Maine Seed Improvement Ass'n.*

AND THE HEADS AND ASSOCIATES OF STATION DEPARTMENTS, AND THE DEAN OF THE COLLEGE OF AGRICULTURE

THE STATION STAFF

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	CHARLES C. INMAN,	*Clerk*
	MARY L. NORTON,	*Clerk*
	MARGARET M. HONEY,	*Clerk*
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	KARL SAX, SC. D.,	*Biologist*
	MARJORIE GOOCH, B. S.,	*Assistant*
	MILDRED R. COVELL,	*Clerk*
	EMMELINE D. WILSON,	*Laboratory Assistant*
CHEMISTRY	JAMES M. BARTLETT, M. S.,	*Chemist*
	ELMER R. TOBEY, CH. E.,	*Associate*
	C. HARRY WHITE, PH. C.,	*Assistant*
ENTOMOLOGY	EDITH M. PATCH, PH. D.,	*Entomologist*
	ALICE W. AVERILL,	*Laboratory Assistant*
PLANT PATHOLOGY	DONALD FOLSOM, PH. D.,	*Pathologist*
	REINER BONDE, B.S.,	*Assistant Plant Pathologist*
	LOUISE M. BAKER,	*Laboratory Assistant*
AROOSTOOK FARM	HUGH B. SMITH,	*Assistant Biologist*
	PERLEY H. DOWNING,	*Superintendent*
HIGHMOOR FARM	WELLINGTON SINCLAIR,	*Superintendent*
	IVA A. MERCHANT, B.S.,	*Scientific Aid*

*Until June 17.
†Until April 3.

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

ORGANIZATION JULY TO DECEMBER, 1924

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*Beginning June 17.
†Beginning April 3.

The publications of this Station will be sent free to any address in Maine. All requests should be sent to

Agricultural Experiment Station,
Orono, Maine.

CONTENTS

ANNOUNCEMENTS

Establishment of the Station

The Maine Fertilizer Control and Agricultural Experiment Station, established by Act of the Legislature approved March 3, 1885, began its work in April of that year in quarters furnished by the College. After the Station had existed for two years, Congress passed what is known as the Hatch Act, establishing agricultural experiment stations in every state. This grant was accepted by the Maine Legislature by an Act approved March 16, 1887, which established the Maine Agricultural Experiment Station as a department of the University. The reorganization was effected in June, 1887, but work was not begun until February 16, 1888. In 1906, Congress passed the Adams Act for the further endowment of the stations established under the Hatch Act.

The purpose of the experiment stations is defined in the Act of Congress establishing them as follows:

"It shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantage of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manure, natural and artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective states or territories."

The work that the Experiment Station can undertake from the Adams Act fund is more restricted and can "be applied only to paying the necessary expenses for conducting original researches or experiments bearing directly on the agricultural industry of the United States, having due regard to the varying conditions and needs of the respective states and territories."

INVESTIGATIONS.

The Station continues to restrict its work to a few important lines, believing that it is better for the agriculture of the State to study thoroughly a few problems than to spread over the whole field of agricultural science. It has continued to improve its facilities and segregate its work in such a way as to make it an effective agency for research in agriculture. Prominent among the lines of investigation are studies upon the food of man and animals, the diseases of plants and animals, breeding of plants and animals, orchard and field experiments, poultry investigations, and entomological research.

INSPECTIONS.

Up to the close of the year 1913, it had been the duty of the Director of the Station to execute the laws regulating the sale of agricultural seeds, apples, commercial feeding stuffs, commercial fertilizers, drugs, foods, fungicides and insecticides, and the testing of the graduated glassware used by creameries. Beginning with January, 1914, the purely executive part of these laws is handled by the Commissioner of Agriculture. It is still the duty of the Director of the Station to make the analytical examination of the samples collected by the Commissioner and to publish the results of the analyses. The cost of the inspections is borne by fees and by a State appropriation.

OFFICES AND LABORATORIES.

The offices, laboratories and poultry plant of the Maine Agricultural Experiment Station are at the University of Maine, Orono. Orono is the freight, express, post, telegraph and telephone address for the offices and laboratories.

AROOSTOOK FARM.

By action of the Legislatures of 1913 and 1915 a farm was purchased in Aroostook County for scientific investigations in agriculture to be under "the general supervision, management, and control" of the Maine Agricultural Experiment Station. The farm is in the town of Presque Isle, about 2 miles south of the village, on the main road to Houlton. The Bangor and Aroostook railroad crosses the farm.

The farm contains about 275 acres, about half of which is cleared. The eight room house provides an office, and home for the farm superintendent. A school house on a lot adjoining the farm was presented to the State by the town of Presque Isle and after being remodeled serves as a boarding house for the help. A greenhouse and a potato storage house have been erected at the farm by the U. S. Department of Agriculture for use in cooperative work on potato breeding. The large barn affords storage for hay and grain and has a large potato storage house in the basement.

HIGHMOOR FARM.

The State Legislature of 1909 purchased a farm upon which the Maine Agricultural Experiment Station was directed to "conduct scientific investigations in orcharding, corn and other farm crops." The farm is situated largely in the town of Monmouth. It is on the Farmington Branch of the Maine Central Railroad, 2 miles from Leeds Junction. A flag station, "Highmoor," is on the farm.

The farm contains 225 acres, about 200 of which are in orchards, fields, and pastures. There are in the neighborhood of 3,000 apple trees upon the place which have been set from 20 to 30 years. The house has 2 stories with a large wing, and contains about 15 rooms. It is well arranged for the Station offices and for the home of the farm superintendent. A substantially constructed building for apple packing was erected in 1912.

The removal of the crossbred herd from the University to Highmoor necessitated considerable change in the barns and the building of a new one 80x36 to accommodate the herd. This barn has a basement for manure, the cow stanchions above, and a loft for storage of hay.

PUBLICATIONS.

The Station is organized so that the work of investigation is distinct from the work of inspection. The results of investigation are published in the bulletins of the Station and in scientific journals, both foreign and domestic. The bulletins for the year make up the annual report. The results of the work of inspection are printed in publications known as Official Inspections. These are paged independently of the bulletins and are bound in with the annual report as an appendix thereto. Miscellaneous publications consisting of newspaper notices of bulletins, newspaper bulletins and circulars which are not paged consecutively and for the most part are not included in the annual report are issued during the year.

BULLETINS ISSUED IN 1924.

No. 316. The Importance and Natural Spread of Potato Degeneration Diseases. 28 pages, 4 pages plates.
No. 317. The Buckthorn Aphid. 24 pages.
No. 318. Interpretation of Dairy Pedigrees. 28 pages.
No. 319. The Blueberry Leaf-Beetle and some of its Relatives. 60 pages, 1 page plate.
No. 320. The Influence of Ultra-Violet Light on Nutrition in Poultry. 24 pages, 8 pages plates.
No. 321. Finances, Meteorology, Index. 32 pages.

OFFICIAL INSPECTIONS ISSUED IN 1924.

No. 111. Foods and Drugs. 16 pages.
No. 112. Commercial Feeding Stuffs, 1923-1924. 20 pages.
No. 113. Commercial Fertilizers, 1924. 32 pages.
No. 114. Commercial Agricultural Seeds, 1924. Insecticides and Fungicides, 1924, 20 pages.

PUBLICATIONS FROM THE BIOLOGICAL LABORATORY IN 1924.

Intrauterine Development of the Bovine Fetus in Relation to Milk Yield in Guernsey Cattle. By John W. Gowen. Jour. of Dairy Science, Vol. VII, pp. 311-317, 1924.

Chromosome Behavior in a Genus Cross. By Karl Sax and Hally Jolivette Sax. Genetics 9: 454-464, 1924.

Interpretation of Dairy Pedigrees. By John W. Gowen. Annual Report of Maine Agricultural Experiment Station, Bul. 318. pp. 53-80. 1924.

The "Probable Error" in Horticultural Experiments. By Karl Sax. Proceedings of the American Society for Horticultural Science. pp. 252-256. 1924.

The Nature of Size Inheritance. By Karl Sax. Proceedings of the National Academy of Sciences, Vol. 10, No. 6, pp. 224-227. 1924.

A Genetic and Cytological Study of Certain Hybrids of Wheat Species. By Karl Sax and E. F. Gaines. Jour. of Agr. Research. Vol. XXVIII, No. 10. pp. 1017-1036. 1924.

Nursery Stock Investigations. By Karl Sax. Proceedings of the American Society for Horticultural Science. pp. 310-312. 1924.

Inheritance of Milk Production. By John W. Gowen. Scientific Agriculture, Vol. IV. No. 12. 365-380 1924.

The Application of the Science of Genetics to the Farmers' Problems. By John W. Gowen. Scientific Agriculture, Vol. V. pp. 1-12. 1924.

The Inheritance of Milk Production and Butter-fat Percentage. By John W. Gowen. Proceedings of the World's Dairy Congress, Vol. 2, pp. 1389-1396. 1923.

Milk Secretion. By John W. Gowen. Williams and Wilkins Co., Baltimore, U. S. A. pp. 1-363.

PUBLICATIONS FROM THE ENTOMOLOGICAL LABORATORY IN 1924.

New Species of Ipidae from Maine. By M. W. Blackman. *In* Technical Publication No. 16 of New York State College of Forestry at Syracuse University, Vol. 22, No. 5. pp. 117-136. 1922.*

Homoptera of the Pribilof Islands, Alaska. By Edith M. Patch. *In* "A Biological Survey of the Pribilof Islands, Alaska." North American Fauna No. 46, Bureau of Biological Survey, U. S. Department of Agriculture. pp. 143-144. 1923.*

Aphididae of Connecticut. By Edith M. Patch. *In* State of Connecticut State Geological and Natural History Survey, Bulletin No. 34, pp. 250-335. 1923.*

Psyllidae of Connecticut. By Edith M. Patch. *In* State of Connecticut State Geological and Natural History Survey, Bulletin No. 34, pp. 243-250. 1923.*

Aphids with Branched Cornicles. By Edith M. Patch. *In* Entomological News. Vol. 35. pp. 331-332. 1924.

The Buckthorn Aphid. By Edith M. Patch. Annual Report of Maine Agricultural Experiment Sation, Bul. 317. pp. 29-52. 1924.

The Blueberry Leaf-beetle and Some of its Relatives. By H. C. Fall and W. C. Woods. Annual Report of Maine Agricultural Experiment Station, Bul. 319. pp. 81-140. 1924.

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*Not previously listed.

STATION NOTES

COUNCIL AND STAFF CHANGES.

Mr. Charles L. Jones of Corinna succeeded Mr. Leonard C. Holston of Yarmouth and the representative of the Maine Livestock Breeders' Association on the Station Council on April 3. Mr. Reiner Bonde was appointed assistant plant pathologist, effective January 1.